CONTRIBUTIONS
FROM THE
CUSHMAN LABORATORY
FOR
FORAMINIFERAL RESEARCH

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Contents

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CUSHMAN LABORATORY FOR FORAMINIFERAL RESEARCH

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These Contributions will be issued quarterly. They will contain short papers with plates, describing new forms and other interesting notes on the general research work on the foraminifera being done on the group by the workers in this laboratory. New literature as it comes to hand will be briefly reviewed.

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CONTRIBUTIONS FROM THE CUSHMAN LABORATORY FOR FORAMINIFERAL RESEARCH

87. SOME VAGINULINAS AND OTHER FORAMINIFERA FROM THE LOWER CRETACEOUS OF TEXAS

By J. A. Cushman and C. I. Alexander

In the Lower Cretaceous of Texas as well as in equivalent formations in other parts of the world, *Vaginulina* is a very striking and common genus. The species are very variable in form and ornamentation. The shape of the test in the microspheric and megalospheric forms differs greatly, and there are so many intergrading stages that a bewildering array presents itself wherever a large series of specimens is available. By careful study of such series, however, some of the dominating characteristics will be found constant throughout while others may change greatly. On the basis of the more constant characters, the forms may be grouped. As a result of the variability in these forms, the literature presents very many specific names that have been used for the different forms of the same species. Some of the forms of the Texas series are here considered and figured.

VAGINULINA KOCHII Roemer

Plate 1, figures 1-9

Vaginulina kochii Roemer, Verst. norddeutsch. Kreide, 1840-41, p. 96, pl. 15, fig. 10.
V. arguta Reuss, Sitz. Akad. Wiss. Wien, vol. 40, 1860, p. 202, pl. 8, fig. 4.—Berthelin, Mém. Soc. géol. France, sér. 3, vol. 1, 1880, p. 42, pl. 2, figs. 7 *a-c* (8 *a, b*?).

Test much compressed, the sides parallel, sutures raised, wall otherwise typically smooth, periphery usually somewhat concave; aperture at the upper angle of the test, radiate.

The whole test is generally triangular in side view, but the outline varies greatly as shown in Plate 1. In the microspheric form the dorsal margin is strongly curved, and the chambers of the initial portion are in a loose coil, while in the megalospheric form the dorsal margin may be nearly straight, and the early chambers show very little of the curve, the whole test being less broad than in the microspheric form.

Roemer's species is apparently the same as that figured later by Reuss, Berthelin and others from the Lower Cretaceous of Europe. The raised sutures and concave or flattened periphery remain constant while the shape changes as noted. There are varietal forms that it may be useful to recognize, although in this particular group the surface ornamentation is subject to much variation from smooth to ornamented forms.

The earlier stages particularly, resemble the broad form figured by Roemer, even though in the microspheric form the later portion may become narrower.

The species is fairly common in both the upper and lower portions of the Duck Creek formation. It is usually accompanied by the following variety into which it grades by very slight changes.

The figures given by Chapman, Journ. Roy. Micr. Soc., 1894, pl. 8, figs. 5, 6, ("*V. truncata* Reuss") and 9, ("*V. arguta* Reuss") should all probably be referred to this species.

EXPLANATION OF PLATE 1

FIGS. 1-9. *Vaginulina kochii* Roemer. Both megalospheric and microspheric specimens. Figs. 1, 2, 6, 7, × 30. Figs. 3-5, 8, 9, × 45. These represent but a few of the many variations shown in our material of this species.

FIGS. 10-16. *Vaginulina kochii* Roemer, var. *striolata* Reuss. × 30. Showing the great variation in amount of the ornamentation.

FIGS. 17-22. *Vaginulina recta* Reuss. × 30.

FIGS. 23-26. *Vaginulina marginulinoides* Reuss. × 30.

Figures drawn by Margaret S. Moore.


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VAGINULINA KOCHII Roemer, var. STRIOLATA Reuss
Plate 1, figures 10-16

Vaginulina striolata Reuss, Sitz. Akad. Wiss. Wien, vol. 46, pt. 1, 1862 (1863), p. 46, pl. 3, fig. 7.—Chapman, Journ. Roy. Micr. Soc., 1894, p. 425, pl. 8, fig. 10.
V. strombecki Reuss, l. c., p. 46, pl. 3, fig. 8.
V. comitina Berthelin, Mém. Soc. géol. France, sér. 3, vol. 1, 1880, p. 38, pl. 1, figs. 21 *a-d*.
V. gaultina Berthelin, l. c., p. 39, pl. 1, figs. 22-24.—Chapman, Journ. Roy. Micr. Soc., 1894, p. 425, pl. 8, figs. 8 *a, b*.

In this variety the raised sutures are usually marked by obliquely transverse depressions, breaking the sutures into a series of short oblique ridges. This ornamentation may be very slight or may increase and spread somewhat to the intermediate chamber portions as well as the sutures. Occasionally only a few of the sutures show the ornamentation, and in other specimens in the same series it may involve nearly the whole surface. A series of figures showing some of these variations is given.

The variety occurs with the typical form of the species in the Duck Creek formation. Specimens are especially common at a locality in the lower Duck Creek, 0.9 mi. E. of Fink, Texas in the *Desmoceras brazoense* zone. In the European literature, it occurs under various names as noted above.

VAGINULINA RECTA Reuss
Plate 1, figures 17-22

Vaginulina recta Reuss, Sitz. Akad. Wiss. Wien, vol. 46, 1862 (1863), p. 48, pl. 3, figs. 14, 15.

Test elongate, much compressed, the faces nearly parallel, periphery usually slightly concave; chambers of nearly uniform width throughout, giving a test with nearly parallel sides; sutures raised, test otherwise smooth; aperture at the dorsal angle, radiate.

This species is widely recorded in the Cretaceous of Europe by Reuss, Berthelin, Burrows, Sherborn and Bailey, Chapman, Egger, and Franke. It is close to *V. kochii* in many of its characters, but may be distinguished by the narrow test with nearly parallel sides.

Our specimens from Texas are from the Denton formation where it is especially common near the Fort Worth-Denton contact, 1.5 miles W. of Krum, Denton County. It also occurs in the Denton, 5

mi. S. of Fort Worth and apparently in the Weno, 5 mi. SE. of Fort Worth.

VAGINULINA MARGINULINOIDES Reuss

Plate 1, figures 23-26

Vaginulina marginulinoides Reuss, Sitz. Akad. Wiss. Wien, vol. 46, 1862 (1863), p. 44, pl. 3, fig. 2.

V. incompta Reuss, l. c., p. 45, pl. 3, fig. 5.

Test elongate, much compressed, dorsal margin thinner than the ventral one so that the faces are not quite parallel, periphery slightly convex; sutures distinct, flush with the surface or even slightly depressed; wall of the chambers smooth; aperture at the dorsal angle, radiate.

This species resembles *V. recta* Reuss in general appearance especially the narrower forms, but it may be distinguished from that species by the lack of sculpture due to the sutures not being raised and the difference in the dorsal and ventral peripheries.

This species is abundant in the Goodland formation of Texas occurring at Cragin Knobs, 6 mi. W. of Fort Worth; at Lake Worth Dam near Fort Worth; and W. of Sanger, Denton County.

There are two forms shown here which it may be found of use to distinguish, one much broader than the other, but there are numerous gradations.

VAGINULINA INTUMESCENS Reuss

Plate 2, figures 1-6

Vaginulina intumescens Reuss, Sitz. Akad. Wiss. Wien, vol. 46, 1862 (1863), p. 49, pl. 4, fig. 2.

Test much compressed, faces parallel, dorsal margin with a nearly straight median carina, ventral margin rounded; chambers numerous, each extending nearly to the base, giving a rounded, protuberant appearance to the ventral margin; sutures distinct, but often more or less obscured by the ornamentation of the surface which consists of longitudinal costae, very variable in number and strength, in general, parallel with the dorsal margin; aperture at the dorsal angle, radiate.

This variable species is often abundant in Texas in the Goodland formation. Our records include Cragin Knobs, 6 mi. W. of Fort Worth; Lake Worth Dam, near Fort Worth; 3.5 mi. W. of Godley; and W. of Sanger, Denton County.

Reuss's species from the Cretaceous of Germany seems to be identi-

cal with this Goodland species. The costae are very variable, but the peculiar swollen ventral margin in side view is very characteristic. A number of figures are given showing the variations that occur in our material.

AMMOBACULITES SUBCRETACEA Cushman and Alexander, n. sp.

Plate 2, figures 9, 10

Test small, compressed, earlier portion close coiled, later three or four chambers uncoiled in a straight linear series, only slightly increasing in diameter as added, the greatest diameter of each chamber below the middle; sutures indistinct in the coiled portions, slightly depressed in the uncoiled portion; wall coarsely arenaceous, of angular, clear grains with a small amount of light gray cement, surface somewhat roughened; aperture terminal, narrowly elliptical. Length up to 0.70 mm.; diameter of coiled portion 0.35 mm.

Holotype (Cushman Coll. No. 12514) from upper middle Goodland formation at Lake Worth, near Fort Worth, Texas.

In its compressed form this resembles somewhat the Recent *Ammobaculites foliaceus*. It is fairly common in the Goodland formation and shows various degrees of compression, but the subpyriform shape of the uncoiled chambers remains constant.

EXPLANATION OF PLATE 2

FIGS. 1-6. *Vaginulina intumescens* Reuss. × 35.

FIGS. 7, 8. *Ammobaculites goodlandensis* Cushman and Alexander, n. sp. × 35. Fig. 7, Holotype. *a* side view; *b*, apertural view.

FIGS. 9, 10. *Ammobaculites subcretacea* Cushman and Alexander, n. sp. × 45. Fig. 9, Holotype. *a*, *a*, side views; *b*, *b*, apertural views.

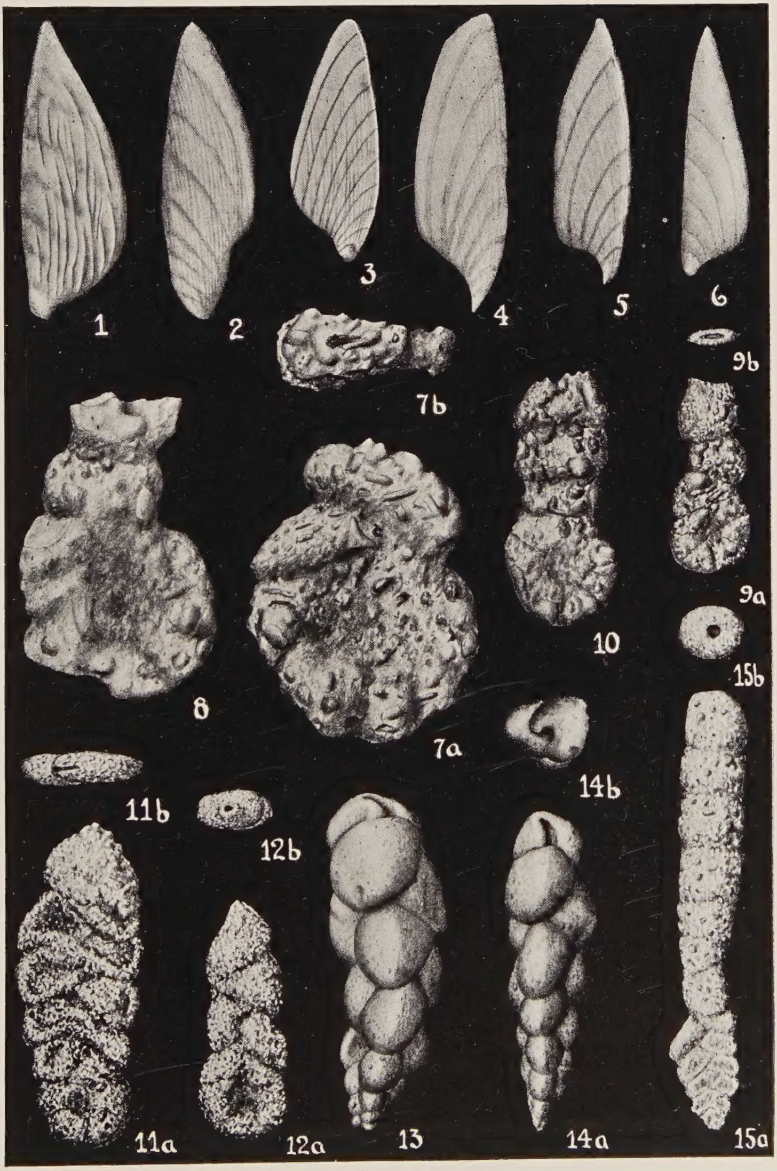
FIG. 11. *Spiroplectammina scotti* Cushman and Alexander, n. sp. × 35. *a*, side view; *b*, apertural view.

FIG. 12. *Spiroplectammina whitneyi* Cushman and Alexander, n. sp. × 80. *a*, side view; *b*, apertural view.

FIGS. 13, 14. *Verneuilina schizea* Cushman and Alexander, n. sp. × 80. Fig. 14, Holotype. *a*, side view; *b*, apertural view.

FIG. 15. *Bigenerina wintoni* Cushman and Alexander, n. sp. × 35. *a*, side view; *b*, apertural view.

Figures drawn by Margaret S. Moore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AMMOBACULITES GOODLANDENSIS Cushman and Alexander, n. sp.
Plate 2, figures 7, 8

Test comparatively large and stout, the earlier portion close coiled, later two or three chambers uncoiled, the earlier portion with the central area depressed and concave, the periphery broad and truncate, the peripheral portions of the chambers broad and raised above the general surface, uncoiled chambers somewhat nodose; sutures indistinct except as marked by the depressions between the chambers; wall of coarse angular fragments with a considerable proportion of light gray cement; aperture elliptical, terminal. Diameter up to 0.90 mm.; length up to 1.20 mm.

Holotype (Cushman Coll. No. 12510) from the Goodland formation at Cragin Knobs, at road level, 6 mi. W. of Fort Worth, Texas.

This is a large, nodose species, fairly common in this formation and unlikely to be confused with any of the other species of the genus. Most of the specimens are young ones still in the coiled stage, and adult ones showing the complete uncoiled test are comparatively rare.

SPIROPLECTAMMINA SCOTTI Cushman and Alexander, n. sp.
Plate 2, figures 11 *a, b*

Test elongate, much compressed, earlier portion close coiled, somewhat umbilicate, later and larger portion biserial, composed of five or more pairs of chambers, increasing in diameter as added, periphery lobulate; sutures indistinct except as marked by the depressions between the chambers; wall coarsely arenaceous, of clear, angular grains with a small proportion of light gray cement; aperture not well shown in the specimens. Length of holotype 1.20 mm.; breadth 0.50 mm.

Holotype (Cushman Coll. No. 12521) from basal Goodland formation, below Lake Worth Dam, near Fort Worth, Texas.

The species is named for Professor Gayle Scott of Texas Christian University.

SPIROPLECTAMMINA WHITNEYI Cushman and Alexander, n. sp.
Plate 2, figures 12 *a, b*

Test small, elongate, the early portion close coiled and somewhat compressed, slightly umbilicate, later portion biserial, only slightly compressed, of even diameter, strongly lobulate on the periphery; chambers becoming somewhat more elongate as added; sutures of the

early coiled portion indistinct, those of the biserial portion distinct and depressed; wall arenaceous of clear angular fragments of rather uniform size, neatly finished on the exterior with a very small amount of cement hardly visible between the fragments; aperture elliptical, terminal. Length of holotype 0.40 mm.; breadth 0.17 mm.; thickness 0.09 mm.

Holotype (Cushman Coll. No. 12523) from basal Goodland formation below Lake Worth Dam, near Fort Worth, Texas.

The species is a distinct one with the peculiar "braided" appearance of the biserial chambers which are of uniform diameter, the apertural end in the later ones becoming elongated.

The species which is fairly common in the basal Goodland formation is named in honor of Professor Whitney of the Geological Department of the University of Texas.

BIGENERINA WINTONI Cushman and Alexander, n. sp.
Plate 2, figures 15 *a, b*

Test very elongate, the early portion biserial, much compressed, the broad faces flattened or even slightly concave, later portion very long and nearly cylindrical or slightly increasing in diameter in the earlier portion; chambers of the biserial portion distinct, the middle portion of each somewhat depressed, those of the uniserial cylindrical portion indistinct; sutures of the biserial portion raised and limbate, those of the uniserial portion indistinct; wall coarsely arenaceous, made up of small fragments as well as tests of other foraminifera, with much light gray cement; aperture small, circular, terminal. Length up to 1.75 mm.; breadth of biserial portion 0.25-0.30 mm.; diameter of uniserial portion 0.26-0.35 mm.

Holotype (Cushman Coll. No. 12508) from Duck Creek formation, about 2 mi. N. of Dennison, Texas, where it is fairly common.

This is a distinctive species with the very flattened biserial portion and elongate uniserial portion, rounded in section.

This species is named in honor of Professor Winton of the Geological Department of Texas Christian University.

VERNEUILINA SCHIZEA Cushman and Alexander, n. sp.
Plate 2, figures 13, 14

Test small, triserial, tapering to the blunt initial end from the greatest width at the base of the last whorl of chambers at the aper-

tural end; chambers very distinct and inflated, giving a lobulate outline to the test, generally triserial, but somewhat irregularly so; sutures distinct, deeply depressed; wall finely arenaceous with a large proportion of cement, under low power often appearing calcareous, smoothly finished; aperture large, on the inner face of the last-formed chamber. Length up to 0.60 mm.; diameter up to 0.18 mm.

Holotype (Cushman Coll. No. 12525) from basal Goodland formation below Lake Worth Dam, near Fort Worth, Texas.

This somewhat resembles some of the Cretaceous specimens that have been referred to *Bulimina polystropha* Reuss, the original figure of which shows a rather even outline not at all like that of our species.

Verneuilina schizea is fairly common in the Lower Cretaceous of Texas, especially in the Goodland formation.

PATELLINA SUBCRETACEA Cushman and Alexander, n. sp.
Plate 3, figures 1 *a, b*

Test small, scale-like, in a low spreading spire, the ventral side concave, dorsal side slightly convex, periphery acute; chambers fairly distinct, early portion consisting of several coils of undivided tube, later chambers narrow and elongate, about two in each whorl; sutures fairly distinct, not depressed; wall translucent, calcareous, smooth; aperture ventral, elongate. Diameter 0.35 mm.; height 0.12 mm.

Holotype (Cushman Coll. No. 12517) from upper Goodland formation, Westover Hills, Fort Worth, Texas.

This is a very low, scale-like form with the early whorls showing primitive characters. The chambers are less distinctly sub-divided than are the late Tertiary and living forms.

88. SOME NOTES ON THE GENUS PATELLINA

By Joseph A. Cushman

Many different things have been placed under the genus *Patellina* since it was described by Williamson in 1858. Fortunately the genus is a monotypic one, and the genoholotype, *Patellina corrugata* Williamson, is a well characterized and common species on the coasts of western Europe and elsewhere. The genus in the sense of Williamson, based on *P. corrugata* and allied species, may be defined as follows:

Test conical or plano-convex, early whorls undivided, and occasionally entire specimens without divisions and like *Spirillina*, later whorls usually divided into long semi-lunate chambers, only two or three usually making up a whorl; typically with internal sinuous septa; wall calcareous, perforate, thin; aperture elongate at the base of the ventral side of the chamber.

Owing to the early coils being often undivided and like *Spirillina*, *Patellina* is placed as one of the most primitive genera of the Rotaliidae. The geologic history of the genus now shows it to range from Permian to Recent. The earliest species are primitive, as would naturally be the case, and the living species are as complex as any except one form which seems to show somewhat advanced stages in having annular chambers as will be noted later. Some of the species are not well defined, and more must be known about them before they can be placed in the genus with certainty, while others recorded as *Patellina* are now known to belong to other genera. A brief resumé of the species follows.

Palaeozoic (Permian)

PATELLINA PROTEA Cushman and Waters

Patellina protea Cushman and Waters, Contr. Cushman Lab. Foram. Res., vol. 4, 1928, p. 54, pl. 7, figs. 8-10.

This is a small, very primitive form from the Permian of Texas, and is one of the earliest records of any of the Rotaliidae, some of the earlier records from the Palaeozoic given by Brady evidently being

errors due to causes not yet determined. The septa of the Permian specimens are incomplete and less well marked than in later species.

The *Patellina bradyana* of Howchin (Journ. Roy. Micr. Soc., 1888, p. 544, pl. 9, figs. 22-25) from the Carboniferous of Australia is not *Patellina*, and has been made the genotype of *Howchinia* Cushman.

Cretaceous

PATELLINA SUBCRETACEA Cushman and Alexander

This species described on a previous page is one of the earliest records of the Post-Palaeozoic. It shows that the genus has already become well developed and typical in Lower Cretaceous times. It may be noted here that Chapman records *Patellina corrugata* from the Cretaceous (Bargate Beds) of Surrey, England (Quart. Journ. Geol. Soc., vol. 50, 1894, p. 718).

PATELLINA ANTIQUA Chapman

Plate 3, figures 3 *a-c*

Patellina antiqua Chapman, Quart. Journ. Geol. Soc., vol. 50, 1894, p. 718, pl. 33, fig. 12 *a-c*.

Under this name, Chapman describes a peculiar spiral form from the Cretaceous (Bargate Beds) of Surrey, England. It is plano-convex and the very elongate chambers apparently sub-divided. A very similar form occurs in Lower Cretaceous material from the upper Goodland formation of the Westover Hills, Fort Worth, Texas.

EXPLANATION OF PLATE 3

Figs. 1 *a, b.* *Patellina subcretacea* Cushman and Alexander, n. sp. × 80. *a,* dorsal view; *b,* peripheral view.

Fig. 2. *Patellina advena* Cushman. (After type figure.)

Figs. 3 *a-c.* *Patellina antiqua* Chapman. (After type figures.) *a,* dorsal view; *b,* ventral view; *c,* peripheral view.

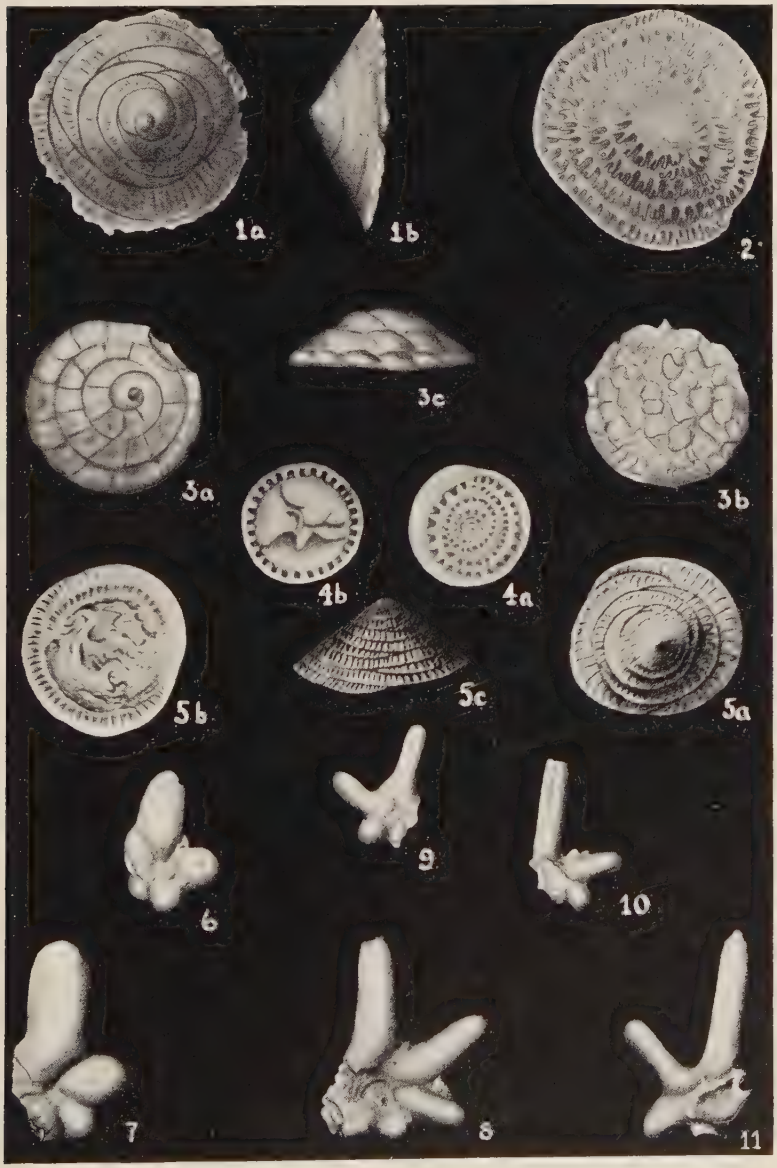
Figs. 4 *a, b.* *Patellina dentata* Terquem. (After type figures.) *a,* dorsal view; *b,* ventral view.

Figs. 5 *a-c.* *Patellina corrugata* Williamson. (After type figures.) *a,* dorsal view; *b,* ventral view; *c,* peripheral view.

Figs. 6, 7. *Hastigerinella eocanica* Nuttall. × 25.

Figs. 8-11. *Hastigerinella jarvisi* Cushman, n. sp. × 25. Fig. 8, Holotype.

Figures drawn by Margaret S. Moore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Under the name *Patellina trochiformis* Schacko, Franke figures a spiral form, apparently undivided, from the Cretaceous of Germany (Abhandl. Preuss. Geol. Landes., n. ser., vol. 111, 1928, p. 17, pl. 1, fig. 20).

Howchin describes and figures a high conical form as *Patellina jonesi* from the Cretaceous of Australia (Trans. Roy. Soc. So. Australia, vol. 19, 1895, p. 198, pl. 10, figs. 9-11). It is an interesting form which needs further study.

The *Patellina oolithica* of Terquem (Mém. Soc. géol. France, sér. 3, vol. 4, 1886, p. 59, pl. 7, figs. 2-4) from the Fuller's Earth near Varsovie, France, is probably not a *Patellina*.

Patellina texana (Roemer) as recorded by Hill (Proc. Biol. Soc. Washington, vol. 8, 1893, p. 20, pl. 1, figs. 2 *a-d*) is of course an *Orbitolina*.

Tertiary

PATELLINA DENTATA Terquem

Plate 3, figures 4 *a, b*

Patellina dentata Terquem, Mém. Soc. géol. France, sér. 3, vol. 2, 1882, p. 123, pl. 12 (20), figs. 36, 37.

The figures given by Terquem from the Eocene of Vaudancourt, show that a species of *Patellina* occurs there, but the details as is usual in Terquem's figures leave much to be desired. It may be noted here that Halkyard (Mem. Proc. Manchester Lit. Philos. Soc., vol. 62, pt. 2, 1918(1919), p. 106) records "*Patellina corrugata*" from the Blue Marl of the Eocene of Biarritz, closely related in age to the Paris Basin Eocene.

Heron-Allen and Earland also record "*P. corrugata*" from the Miocene of Filter Quarry, Victoria, Australia (Journ. Roy. Micr. Soc., 1924, p. 167) "A single specimen of a very depressed and scale-like form". Chapman under the same name figures a peculiar form from the Miocene of New Zealand (New Zealand Geol. Surv., Pal. Bull., No. 11, 1926, p. 75, pl. XV, fig. 5).

Paalzow figures as *P. corrugata* a very high conical form from the Oligocene-Cerithiensand of Offenbach a. Main, Germany (Ber. Offenb. Ver. Nat., 1912-24(1924), p. 23, pl. 2, figs. 6 *a, b*).

Terquem's *Patellina nitida* from the Eocene of the Paris Basin at Septeuil (p. 123, pl. 12 (20), fig. 38 *a-c*) probably is a *Discorbis*.

Some other specific names are unaccompanied by figures such as *Patellina major* and *P. minor* of Hantken and some others which belong to *Dictyoconus* or other related genera.

The other late Tertiary records are of species found now living in the present oceans, and will be included under the Recent species.

Recent

PATELLINA CORRUGATA Williamson

Plate 3, figures 5 *a-c*

Patellina corrugata Williamson, Rec. Foram. Gt. Britain, 1858, p. 46, pl. 3, figs. 86-89.—H. B. Brady, Trans. Linn. Soc. Zool., vol. 24, 1864, p. 471; Nat. Hist. Trans. Northumberland and Durham, vol. 1, 1865 (1867), p. 105.—Parker and Jones, Philos. Trans., vol. 155, 1865, p. 398, pl. 15, figs. 29 *a-c*.—H. B. Brady, Ann. Mag. Nat. Hist., ser. 4, vol. 6, 1870, p 66.—Terquem, Essai Class. Anim. Dunkerque, 1875, p. 31, pl. 4, figs. 3 *a, b*.—H. B. Brady, Ann. Mag. Nat. Hist., ser. 5, vol. 8, 1881, p. 412; Denkschr. Akad. Wiss., vol. 43, 1881, p. 16; Rep. Voy. *Challenger*, Zoology, vol. 9, 1884, p. 634, pl. 86, figs. 1-7.—Balkwill and Wright, Trans. Roy. Irish Acad., vol. 28, 1885, p. 349.—Siddall, Proc. Lit. Phil. Soc. Liverpool, 1886, p. 70.—Halkyard, Trans. Manchester Micr. Soc., 1889, p. 69.—Chaster, First Rep't Southport Soc. Nat. Sci., 1890-91 (1892), p. 65.—Wright, Proc. Roy. Irish Acad., ser. 3, vol. 1, 1891, p. 489.—Woodward, The Observer, vol. 4, 1893, p. 176.—Goës, Kongl. Svensk. Vet. Akad. Handl., vol. 25, No. 9, 1894, p. 92.—Morton, Proc. Portland Soc. Nat. Hist., vol. 2, 1897, p. 120.—Reade, Geol. Mag., dec. 4, vol. 7, 1900, pl. 5, fig. 20.—Wright, Irish Nat., vol. 9, 1900, p. 55.—Kiaer, Rep't Norwegian Fish Mar. Invest., vol. 1, No. 7, 1900, p. 23.—Whiteaves, Geol. Surv. Canada, 1901, p. 10.—Earland, Journ. Quekett Micr. Club, ser. 2, vol. 9, 1905, p. 220.—Millett, Rec. Foram. Galway, 1908, p. 6.—Cushman, Proc. Boston Soc. Nat. Hist., vol. 34, 1908, p. 29, pl. 5, fig. 3.—Sidebottom, Mem. Proc. Manchester Lit. Philos. Soc., vol. 52, 1908, p. 9.—Heron-Allen and Earland, Journ. Roy. Micr. Soc., 1909, p. 441.—Sidebottom, Mem. Proc. Manchester Lit. Philos. Soc., vol. 54, No. 16, 1910, p. 24.—Heron-Allen and Earland, Proc. Roy. Irish Acad., vol. 31, pt. 64, 1913, p. 109, pl. 9, fig. 11.—Pearcey, Trans. Roy. Soc. Edinburgh, vol. 49, 1914, p. 1026.—Cushman, Bull. 71, U. S. Nat. Mus., pt. 5, 1915, p. 9, pl. 7, fig. 1.—Heron-Allen and Earland, Journ. Roy. Micr. Soc., 1916, p. 49; Trans. Linn. Soc. London, vol. 11, 1916, p. 269.—Cushman, Contr. Canadian Biol., 1921 (1922), p. 11.—Hofker, Flora en Fauna de Zuiderzee, Protozoa, 1922, p. 134, fig. 13 *a-d* (in text).—Casasnovas, Not. Y Res. Instit. Esp. Ocean., ser. 2, No. 29, 1928, p. 6.—Palmer, Journ. Pal., vol. 3, 1929, p. 306.

The above references seem to refer to Williamson's species, and are mostly from the North Atlantic. A few others are not included but might be placed here. The species is known from the Arctic, the At-

lantic coasts of Europe, and from the Mediterranean if the latter records are the same species and from the North Pacific. I have Mediterranean material that is in some points different from Recent Atlantic material, but many more specimens are desirable for full study. It is found fossil in the late Tertiary of the British Isles and possibly elsewhere, although the records should be checked.

Heron-Allen and Earland have called attention to two forms, one with a small proloculum, a more oval test and more chambers which may represent the microspheric form, and a second with larger proloculum, more rounded form and fewer chambers which may represent the megalospheric form. The test is simpler in its structure than the following species. Many records for *P. corrugata* from the Indo-Pacific area are included provisionally under *P. advena*.

PATELLINA ADVENA Cushman

Plate 3, figure 2

Patellina advena Cushman, U. S. Geol. Survey, Prof. Paper 129-F, 1922, p. 135, pl. 31, fig. 9; Prof. Paper 133, 1923, p. 37; Publ. 342, Carnegie Instit. Washington, 1924, p. 32.— Cushman and Wickenden, Proc. U. S. Nat. Mus., vol. 75, Art. 9, 1929, p. 11, pl. 4, figs. 10 *a-c*.

Patellina corrugata Egger, (in part?) Abhandl. kön. bay. Akad. Wiss. München, Cl. II, vol. 18, 1893, p. 393, pl. 15, figs. 70-72.—Chapman, Journ. Linn. Soc. Zool., vol. 28, 1902, p. 384.—Rhumbler, Zool. Jahrb., Abt. Syst., vol. 24, 1906, p. 35.—Chapman, Subantarctic Islands of New Zealand, 1909, p. 354; Zool. Res. *Endeavour*, pt. 3, 1912, p. 311; Biol. Res. *Endeavour*, vol. 3, pt. 1, 1915, p. 28.—Heron-Allen and Earland, Trans. Zool. Soc. London, vol. 20, 1915, p. 686.—Sidebottom, Journ. Roy. Micr. Soc., 1918, p. 251.—Cushman, Bull. 100, U. S. Nat. Mus., vol. 4, 1921, p. 303. Heron-Allen and Earland, British Antarctic Exped., Zool., vol. 6, 1922, p. 198, pl. 7, fig. 5; Journ. Linn. Soc. Zool., vol. 35, 1924, p. 629.

The above references under *P. corrugata* are those of the general Indo-Pacific region, and should be checked to see that they are *P. advena*.

P. advena is known from the Oligocene of the Coastal Plain region of the United States, and like numerous other species of that fauna, is now living in the Indo-Pacific. The septa are fewer and much more lobed and complex than those of typical *P. corrugata*, and it seems to represent a higher development.

The *Patellina punctata* Terquem (Essai Class. Anim. Dunkerque, 1881, p. 128, pl. 16, figs. 9 *a, b*) may be a Recent specimen belonging

to *P. corrugata*, or may be one of the fossil species which occur in the material recorded by Terquem from this area. The figure is not conclusive. The *Patellina plicata* Terquem of the same paper (p. 72, pl. 8, figs. 9 *a, b*) is a *Trochammina*.

The high spired, thick-walled species described by Brady in the *Challenger* report as *Patellina campanaeformis* does not seem to be a true *Patellina*.

Parker and Jones have given the name *Orbitolina annularis* to a peculiar form found on the coast of Australia (Ann. Mag. Nat. Hist., ser. 3, vol. 6, 1860, p. 31) later referred to *Patellina corrugata* (Carpenter, Parker and Jones, Introd. Foram., 1862, p. 230, pl. 13, figs. 16, 17). These are large specimens with annular chambers and need further study. They have been referred to as *Patellina corrugata*, var. *annularis* by Heron-Allen and Earland (Rept. British Antarctic Exped. Zoology, vol. 6, 1922, page 198). They mention that their New Zealand specimens represent transition stages. In my own New Zealand collections, there are specimens in which the divisions into chambers are few, but no annular chambers occur. With these are specimens of *P. advena* Cushman. Chapman figures a form with apparently annular chambers, but the early portion with subglobular chambers (Journ. Quekett Micr. Club, ser. 2, vol. 10, 1907, p. 134, pl. 10, fig. 7).

The fossil and Recent members of this group which are found in the Australian region seem particularly worthy of special study.

89. FOSSIL SPECIES OF HASTIGERINELLA

By Joseph A. Cushman

The genus *Hastigerinella* is one of the most specialized of the Globigerinidae. Its genoholotype, *H. digitata* (Rhumbler), is known only as a pelagic form in Recent seas. The chambers are very elongate, somewhat club-shaped, and at the ends have very long slender spines. The early chambers are *Globigerina*-like and subglobular, the later ones becoming gradually elongate. The aperture is large, at the base of the chamber.

The Recent species was the only one described until Nuttall figured and described a species from the Eocene of Mexico. In the Upper Eocene of Trinidad, Nuttall's species occurs and another slightly more specialized species described below. The material in which the Trinidad specimens occur is a typical *Globigerina*-ooze, the assemblage of which except for the specimens of *Hantkenina* is much the same as that found in rather deep water of the Caribbean at the present time. *Hastigerinella* has not been recorded in later Tertiary deposits although these fossil species must be the ancestors of the living species. The gap between the Upper Eocene and Recent may later be filled in when the deeper water deposits of the later Tertiary which are now found in some parts of the West Indian region are studied.

HASTIGERINELLA EOCANICA Nuttall
Plate 3, figures 6, 7

Hastigerinella eocanica NUTTALL, Journ. Pal., vol. 2, 1928, p. 376, pl. 50, figs. 9-11.

Nuttall's description is as follows: "Test with earlier portion trochoid, later development planispiral. Earlier chambers globigeriniform, later chambers elongate with rounded smooth extremities. Aperture not preserved in the specimens examined. Average length 0.7 mm.

"This species is readily distinguished from *H. digitata* (Rhumbler), the only other described species of the genus. The latter bears spines on the end of the later chambers."

The Trinidad specimens here figured were collected by Mr. P. W. Jarvis from the Eocene, "Lowest Marl", associated with *Hantkenina* at the following localities: South end of Hospital Hill, San Fernando; just South of Hospital Hill, North end of Point Bontour Hill, San Fernando, and also from 12½ miles on Guaracara-Tabaquite road. The specimens show the blunt lobed chambers of the same general form as those figured by Nuttall whose types are in my collection. The outer ends of the chambers are rounded and smooth.

HASTIGERINELLA JARVISI Cushman, n. sp.
Plate 3, figures 8-11

Test with the early chambers slightly trochoid, close coiled and generally globular, later ones becoming much elongate, often 3 or 4 times as long as wide, the ends in some specimens somewhat contracted and with roughened projections, probably the bases of spines, the length

of the chambers increasing very rapidly as added; wall finely perforate, smooth except for the ends of the chambers; aperture an arched opening nearly the width of the chamber at the base on the ventral side. Diameter up to 0.55 mm.

Holotype (Cushman Coll. No. 12565) from Eocene, "Upper Marl", 17¼ miles out on Cunapo Southern road, Trinidad, collected by Mr. P. W. Jarvis. Another series of specimens is from a collection made by Mr. Jarvis on Cush River, E. of Tabaquite, Trinidad.

The chambers in this species are relatively much slenderer than in *H. eocanica*, and the ends of the chambers are often somewhat pointed and spinose. The two species are not found together so far as I have seen.

The species is named in honor of Mr. P. W. Jarvis who has done such extensive collecting of Trinidad foraminifera.

RECENT LITERATURE ON THE FORAMINIFERA

Below are given some of the more recent works that have come to hand.

Yabe, H. and Shoshiro Hanzawa.
Tertiary Foraminiferous Rocks of the Philippines.
(Sci. Rept. Tohoku Imperial Univ., sec. ser. (Geol.), vol. XI, No. 3, 1929, pp. 137-190 (1-54), pls. XV-XXVII (I-XIII).) *Sendai.*
Many beautiful figures from photographs are given, and numerous species are described. One new name is given.

Yabe, Hisakatsu, Renjiro Aoki and Shoshiro Hanzawa.
The Miocene Age of the Elevated Limestone of Suva, Viti Levu, Fiji Islands.
(Proc. Third Pan-Pacific Congress, Tokyo, 1926, pp. 1813-1817, text figs. 1-3.) *Tokyo.*
The occurrence of numerous foraminifera is noted, and a few sections figured.

Hucke, K.
Über ein grossesnummuliten führendes. Eozängeschiebe von Cöthen (Anhalt).
(Zeitschr. für Geschiebeforschung, Bd. V, Heft 3, 1929, pp. 99-102.) *Berlin.*
Notes the occurrence of several *Nummulites.*

Davis, A. G.
Über die Fauna eines Eozängeschiebes von Cöthen (Anhalt).
(L. c., pp. 111-113.) *Berlin.*
Notes several species of foraminifera.

Klähn, Hans.
Ein Nummulitenführendes Geschiebe von Banzkow bei Schwerin (Mecklenberg).
(L. c., pp. 119-124, 2 text figs.) *Berlin.*
Notes several species of foraminifera and figures sections.

Schmitt, Wilhelm.
Tonmergelgeschiebe aus den Gault.
(L. c., pp. 125-128, pl. V.) *Berlin.*
Figures numerous Lower Cretaceous foraminifera.

Ellisor, Alva Christine.
Correlation of the Claiborne of East Texas with the Claiborne of Louisiana.
(Bull. Amer. Assoc. Petr. Geol., vol. 13, No. 10, Oct. 1929, pp. 1335-1346, with charts). *Tulsa.*
Notes occurrence of "*Orthophragmina advena* Cushman".

Van der Vlerk, I. M.
Grotte foraminiferen van N. O. Borneo (with Summary in English).
(Wetenschappelijke Mededeelingen, No. 9, 1929, pp. 1-44, 7 pls.) *Bandoeng.*
Numerous orbitoids and other larger foraminifera are described and figured, 2 new.

Umbgrove, J. H. F.
Lepidocyclina transiens, spec. nov. van Sumatra (with Summary in English).
(L. c., pp. 109-113, 1 pl.) *Bandoeng.*
Describes and figures a new *Lepidocyclina* from Sumatra.

Hucke, K. and E. Voigt.
Beiträge zur Kenntnis der Fauna des nord deutschen Septarientones.
(Zeitschr. Deutsch. Geol. Ges., Bd. 81, Jahrg. 1929, Heft. 3/4, pp. 159-168, pls. VI, VII.) *Berlin.*
A new species of *Flabellina* is described.

Storm, Hugo.
Uebersichtliche Zusammenstellung der gefunden Foraminiferen mit Angabe des Fundortes.
(Lotos, Prag. 77, 1929, pp. 55-62.) *Prague.*
Lists many Cretaceous species with localities.

Storm, Hugo.
Zur Kenntnis der Foraminiferenfauna in Oberturon und Emscher der Böhmischen Kreide formation.
(L. c., pp. 39-54, figs. 1-14.) *Prague.*
Numerous Cretaceous species are described and figured, of which 5 are new.

Crickmay, C. H.

The Anamalous Stratigraphy of Deadman's Island, California.

(Journ. Geol., vol. 37, No. 7, Oct.-Nov. 1929, pp. 617-638).

A few foraminifera are listed.

Cole, W. S.

A New Oligocene Brachiopod from Mexico.

(Bull. Amer. Pal., vol. 15, No. 57a, Nov. 24, 1929, pp. 1-6, pl. 1). *Ithaca.*

A list of associated foraminifera is given.

Vaughan, Thomas Wayland.

Additional New Species of Tertiary Larger Foraminifera from Jamaica.

(Journ. Pal., vol. 3, No. 4, Dec. 1929, pp. 375-383, pls. 39-41). *Austin.*

Six new species and varieties are described and figured.

Weinzierl, Laura Lane and Esther R. Applin.

The Claiborne Formation on the Coastal Domes.

(L. c., pp. 384-410, pls. 42-44). *Austin.*

Numerous foraminifera are described and figured, of which 14 are new.

Church, C. C.

The Occurrence of Kyphopyxa in California.

(L. c., p. 411). *Austin.*

As elsewhere, this occurs in the Cretaceous.

Silvestri, A.

Sul modo do presentarsi delle Alveoline Eoceniche nei loro giacimenti primari.

(Mem. Pont. Accad. Sci. Nuovi Lincei, ser. II, vol. XII, 1929, pp. 465-492, 3 pls., 6 text figs.) *Roma.*

Some excellent figures of sections are given, and a comprehensive bibliography on Eocene Alveolinas.

Silvestri, A.

Protozoi cretacei ricordati e figurati da B. Faujas de Saint-Fond.

(Atti Pont. Accad. Sci. Nuovi Lincei, Anno LXXXII, 1929, pp. 325-343, 1 plate, 9 text figs.). *Roma.*

The original figures and plates of this old paper are reproduced, and their present names are given with copious notes.

Heron-Allen, E. and Arthur Earland.
Some New Foraminifera from the South Atlantic. II.
(Journ. Roy. Micr. Soc., vol. XLIX, 1929, pp. 324-334, pls. I-IV.) *London.*

Describe and figure several new species and one new genus, *Protobotellina.*

Van der Vlerk, I. M. and J. H. L. Wennekers.
Einige foraminiferenführende Kalksteine aus Süd-Palembang (Sumatra).
(Eclogae geologicae Helvetiae, Bd. 22, No. 2, 1929, pp. 166-172, pl. XVI.) *Basel.*

Figure sections of numerous species, none new.

Cole, W. S. and Ruth Gillespie.
Some Small Foraminifera from the Meson Formation of Mexico.
(Bull. Amer. Pal., vol. 15, No. 57b, Feb. 28, 1930, pp. 123-137, [1-15], pls. 18-21, [1-4].) *Ithaca.*

38 species and varieties are treated, 6 of which are described as new.

Cushman, Joseph Augustine.
The Foraminifera of the Atlantic Ocean, Pt. 7, Nonionidae, Camerinidae, Peneroplidae, and Alveolinellidae.
(Bull. 104, U. S. Nat. Mus., pt. 7, 1930, pp. I-VI, 1-79, pls. 1-18.) *Washington.*

The Recent Atlantic species of the above families are described and figured with a very few new ones.

J. A. C.

Dr. Aug. Tobler

Notice has been received of the death of Dr. Tobler at Basel on the 23rd of November, 1929.

Yoshiaki Ozawa

Word has just been received of the death on December 29, 1929, of Dr. Yoshiaki Ozawa, Professor of Paleontology in the Geological Institute of the Imperial University of Tokyo. This sad news is a great shock to his many American and European friends.

I feel personally that I have lost one of my dearest friends for whom I came to have an especial fondness. His personality was a particularly charming one, and his devotion very touching. He was endowed with unusual energy and was mentally exceptionally alert. It was always a pleasure to work with him and to develop new ideas.

In 1927, Dr. Ozawa spent a short time at this Laboratory, and then went to Europe for a year and a half, studying the older type collections and doing extensive collecting from the classic localities. I had the pleasure of being with him again in Europe during this period. He returned to America in January, 1929, and spent the next six months with me in the study of the Polymorphinidae, the results of which are now in press. His very charming wife was with him, and we had hoped to see them in Japan at some future time.

A young man with exceptional endowment and training together with the broadening experiences of two years of foreign study and travel, his scientific future seemed especially bright. To have it so early cut short means a real loss to science in addition to the personal loss of those who knew and loved him.

Jos. A. Cushman.

Sharon, Mass., January 29, 1930.